

Additionally, once orbit parameters are settled upon, the same tools can be used to model system performance, and execute more focused trade studies as requirements are being developed and analyzed. This toolset offers a cohesive

model-based systems engineering tool to be used as mission concepts are developed and in the development and analysis of top-level system requirements.

This work was done by Benjamin M. Haber and Joseph J. Green of Caltech for

NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

This software is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-47236.

Hybrid-PIC Computer Simulation of the Plasma and Erosion Processes in Hall Thrusters

NASA's Jet Propulsion Laboratory, Pasadena, California

HPHall software simulates and tracks the time-dependent evolution of the plasma and erosion processes in the discharge chamber and near-field plume of Hall thrusters. HPHall is an axisymmetric solver that employs a hybrid fluid/particle-in-cell (Hybrid-PIC) numerical approach. HPHall, originally developed by MIT in 1998, was upgraded to HPHall-2 by the Polytechnic University of Madrid in 2006. The Jet Propulsion Laboratory has continued the development of HPHall-2 through

upgrades to the physical models employed in the code, and the addition of entirely new ones.

Primary among these are the inclusion of a three-region electron mobility model that more accurately depicts the cross-field electron transport, and the development of an erosion sub-model that allows for the tracking of the erosion of the discharge chamber wall. The code is being developed to provide NASA science missions with a predictive tool of Hall thruster performance and

lifetime that can be used to validate Hall thrusters for missions.

This work was done by Richard R. Hofer, Ira Katz, and Ioannis G. Mikellides of Caltech and Manuel Gamero-Castano of the University of California, Irvine for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

This software is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-46513.

BioNet Digital Communications Framework

John H. Glenn Research Center, Cleveland, Ohio

BioNet v2 is a peer-to-peer middleware that enables digital communication devices to "talk" to each other. It provides a software development framework, standardized application, network-transparent device integration services, a flexible messaging model, and network communications for distributed applications. BioNet is an implementation of the Constellation Program Command, Control, Communications and Information (C3I) Interoperability specification, given in CxP 70022-01.

The system architecture provides the necessary infrastructure for the integra-

tion of heterogeneous wired and wireless sensing and control devices into a unified data system with a standardized application interface, providing plug-and-play operation for hardware and software systems.

BioNet v2 features a naming schema for mobility and coarse-grained localization information, data normalization within a network-transparent device driver framework, enabling of network communications to non-IP devices, and fine-grained application control of data subscription bandwidth usage. BioNet directly integrates Disruption Tolerant Networking

(DTN) as a communications technology, enabling networked communications with assets that are only intermittently connected including orbiting relay satellites and planetary rover vehicles.

This work was done by Kevin Gifford, Sebastian Kuzminsky, and Shea Williams of the University of Colorado at Boulder for Glenn Research Center.

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18415-1

Real-Time Feature Tracking Using Homography

NASA's Jet Propulsion Laboratory, Pasadena, California

This software finds feature point correspondences in sequences of images. It is designed for feature matching in aerial imagery. Feature matching is a fundamental step in a number of important image processing operations: calibrating the cameras in a camera array, stabilizing im-

ages in aerial movies, geo-registration of images, and generating high-fidelity surface maps from aerial movies.

The method uses a Shi-Tomasi corner detector and normalized cross-correlation. This process is likely to result in the production of some mismatches. The

feature set is cleaned up using the assumption that there is a large planar patch visible in both images. At high altitude, this assumption is often reasonable. A mathematical transformation, called an homography, is developed that allows us to predict the position in